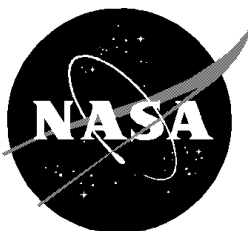# Shuttle Ionospheric Modification with Pulsed Local Exhaust

Payload Integration Plan

Basic
August 1995

NASA

National Aeronautics and
Space Administration

Lyndon B. Johnson Space Center
Houston, Texas

DESCRIPTION OF CHANGES TO

PAYLOAD INTEGRATION PLAN

SPACE SHUTTLE PROGRAM

AND

SHUTTLE IONOSPHERIC MODIFICATION WITH PULSED LOCAL EXHAUST

CHANGE NO.	DESCRIPTION/AUTHORITY	DATE	PAGES AFFECTED
--	Basic issue/P21327-001	08/10/95	All
1	Update sections 1.0 and 3.1/P21327-002	07/11/97	1,3
2	Update sections 1.0, 3.1, and 4.2.2/P21327-0003	02/19/98	1,3,4
3	Update section 4.2.2/P21327-0004	04/10/98	4,4A
4	Update sections 1.0, 3.1, 4.2.2, and 8.3/P21327-0005	02/25/00	1,3,4,4A, 6

Note: Dates reflect latest signature date of CR's received by PILS.

PAYLOAD INTEGRATION PLAN

SPACE SHUTTLE PROGRAM

AND

SHUTTLE IONOSPHERIC MODIFICATION WITH PULSED LOCAL EXHAUST

AUGUST 10, 1995

APPROVED:

Signed by Richard M. Swalin, dated 08/04/95	Signed by James C. McLeroy, dated 08/10/95
SPACE SHUTTLE PROGRAM OFFICE	SIMPLEX PROGRAM OFFICE USAF/SMC

PREFACE

This Payload Integration Plan (PIP) is the United States Air
Force Space and Missile Center (USAF/SMC) on behalf of the Naval
Research Laboratory and National Aeronautics and Space
Administration (NASA) agreement on the responsibilities and tasks
which directly relate to integration of the payload into the
Space Shuttle and includes identification of tasks that the NASA
considers as standard and nonstandard services.

Signature of this document constitutes technical agreement on
tasks to be performed, including standard and nonstandard
services, but does not obligate the USAF/SMC to the reimbursement
price and schedule payment or the NASA to the funding and
implementation of standard or nonstandard services. Upon
provision of funding by the USAF/SMC the standard and nonstandard
services identified will be implemented by the Space Shuttle
Program (SSP). The launch date shown in this PIP is for planning
purposes only.

This document defines only unique requirements for this payload.
Standard requirements imposed on the payload and on the Shuttle
Program are defined in the Shuttle/Payload Standard Integration
Plan for Middeck-Type Payloads, NSTS 21000-SIP-MDK, current
version. Sections of this document where the words "Not
Applicable" appear indicate that the standard requirements do not
apply to this payload. Sections of this document where the words
"No Unique Requirements" appear indicate that only the standard
requirements apply and no additional requirements are imposed on
either the Shuttle or the payload.

Further understanding of SSP operations and the associated
payload-unique requirements may indicate the need for additions
to or deletions from the nonstandard services. This can be
accommodated by amendment of the PIP.

Issues which are yet To Be Resolved (and labeled "TBR" in this
PIP) and additional details are documented in appendix A.
Information not at issue but which is yet To Be Determined is
labeled "TBD" and documented in appendix B.

CONTENTS

1.0 INTRODUCTION

United States Air Force Space and Missile Center (USAF/SMC) on
behalf of the Naval Research Laboratory (NRL) plan to use the
Space Shuttle for examining ionospheric distortions caused by
exhaust of the Orbiter's Orbital Maneuvering System (OMS)
engines. Shuttle Ionospheric Modification with Pulsed Local
Exhaust (SIMPLEX) requires 20 cooperative tests of Orbiter
thruster firings on multiple flights. SIMPLEX will fly as a
standard secondary payload.

SIMPLEX will not fly any hardware on the Shuttle. It is not a
prepacked middeck locker and does not require any John F. Kennedy
Space Center (KSC) processing. SIMPLEX will make use of five
radar locations. They are Arecibo, Puerto Rico, Kwajalein,
Marshall Islands, Millstone Hill, Massachusetts, Alice Springs,
Australia, and Jicamarca, Peru.

For purposes of this Payload Integration Plan (PIP), the Space
Shuttle Program (SSP) shall be composed of and represented by the
Goddard Space Flight Center (GSFC), Lyndon B. Johnson Space
Center (JSC) and the KSC. The SIMPLEX shall be represented by
the USAF/SMC.

This PIP provides the management roles and responsibilities, and
a definition of the technical activities, interfaces, and
schedule requirements to accomplish the integration, launch, on-
orbit operation, and postlanding operations of the SIMPLEX
payload with the Space Shuttle. All services to be furnished by
the SSP to the customer under this PIP shall be furnished by the
SSP using its best efforts.

2.0 MANAGEMENT RESPONSIBILITIES

The responsibility for assuring the definition, control,
implementation, and accomplishment of activities identified in
this document is vested with the SSP at the JSC and for SIMPLEX
with the USAF/SMC. Hereafter in this PIP, the USAF/SMC will be
referred to as the customer, and the SIMPLEX will be referred to
as the payload.

2.1 Joint Responsibilities

No unique requirements

2.1.1 Documentation.- No unique requirements

2.1.2 Reviews.- No unique requirements

2.1.3 Proprietary Data.- No unique requirements

2.2 Space Shuttle Program Responsibilities

No unique requirements

2.3 Customer Responsibilities

No unique requirements

2.4 Authority and Responsibilities of the Space Shuttle
     Commander

No unique requirements

2.5 Authority and Responsibilities of the Payload Commander

No unique requirements

2.6 Authority and Responsibilities of the Mission Management
     Team and the Cargo Management Team

2.6.1 Mission Management Team.- The authority and
responsibilities of the Mission Management Team (MMT) are
established in Space Shuttle Operations, NSTS 07700, Volume VIII.
The MMT, chaired by the Director, Space Shuttle Operations or
designated representative, will function as a program-level
oversight group to review the status of countdown and flight
activities and to make programmatic decisions outside the
authority of the launch and flight teams. When necessary to
deviate from established Launch Commit Criteria (LCC) or flight
rules to safely conduct SSP operations or to meet mission
objectives, the single approval authority for such actions is the
MMT chairman or his designated representative. The single
representative to the MMT on matters involving the Shuttle cargo
is the Flight Manager, Space Shuttle Program.

2.6.2 Cargo Management Team.- The customer's interface to the
MMT is through membership on the Cargo Management Team (CMT).
This team, which is chaired by the SSP Flight Manager, consists
of SSP and customer management representatives who have the

authority and technical knowledge to make final programmatic recommendations to the MMT on issues which affect the payload.

3.0 PAYLOAD DESCRIPTION AND MISSION OVERVIEW

This section contains a general payload description and mission overview. It is not intended to specify requirements or constraints.

3.1 Payload Description

The SIMPLEX payload has no flight hardware; Orbiter OMS thruster firings will be used to create ionospheric disturbances for observation by the SIMPLEX radars. SIMPLEX has five different radar sites used for collecting data: 1) Arecibo, 2) Kwajalein, 3) Millstone Hill, 4) Alice Springs, and 5) Jicamarca. One of the radar sites (Arecibo) will also use a low-level laser to observe the effects on the ionosphere resulting from the thruster firing.

The objective of the SIMPLEX activity is to determine the source of Very High Frequency (VHF) radar echoes caused by the Orbiter and its OMS engine firings. The Principal Investigator (PI) will use the collected data to examine the effects of orbital kinetic energy on ionospheric irregularities and to understand the processes that take place with the venting of exhaust materials. SIMPLEX sensors may collect data during any encounter opportunity when the Orbiter support activities meet the criteria defined.

3.2 Mission Overview

3.2.1 Integrated Ground Operations.- Not applicable

3.2.2 Flight Operations.- Once in orbit, the flightcrew will be available to support cooperative tests that will require Orbiter OMS thruster firings (with specific attitude control) while in a SIMPLEX opportunity timeframe. It is highly desirable that OMS thruster firings be dedicated and SSP planned firings scheduled over a SIMPLEX observation site. SIMPLEX operations and opportunity definitions will be negotiated between the customer and the SSP through the Flight Planning Annex, Annex 2.

3.2.3 Postlanding.- Not applicable

4.0 MISSION OPERATIONS

The mission operations section includes a definition of requirements and constraints by mission phase.

4.1 Payload Control Parameters

Not applicable

4.2 Operational Requirements and Constraints

Details of the SIMPLEX tests to be performed are contained in the Flight Planning Annex, Annex 2, Part II.

4.2.1 Launch Readiness.- Not applicable

4.2.2 On-orbit.- There are no unique altitude or inclination requirements, (desired altitudes for the SIMPLEX tests are at altitudes between 200 and 400 Km). Annex 2, Part II defines the specific support requirements. The SIMPLEX tests are listed below. These are all the possible tests defined for each radar site. The PI will prioritize the types of burns based on the opportunity. The PI prefers that each radar site obtain both night and day burns. However, if both lighting conditions are not available then multiple burn types with the same lighting condition are acceptable. A total of 20 tests are required for the SIMPLEX payload.

Site	Night RAM	Night WAKE	Night PERP	Day RAM	Day WAKE	Day PERP
Arecibo	STS-93					STS-89
Jicamarca			STS-88			STS-86
Millstone Hill						
Kwajalein				STS-93		
Alice Springs				STS-91 STS-93	STS-93	

Increasing Site Priority

Increasing burn priority   Increasing burn priority

Site priority should be accounted for followed by burn priority
- There is no priority between Night and Day burns except for the Alice Springs site where the burn should occur between 20:00 and 24:00 local time.
- The following are the burn constraints for each site.
    * Arecibo prefers two OMS engines with 10 seconds or greater duration but will accept two OMS engines at a minimum of 5 seconds duration. The burn should be within 15° of radar zenith.
    * Jicamarca requires two OMS engines with 10 seconds or greater duration within 3° of radar zenith.
    * Millstone Hill requires two OMS engines with 10 seconds or greater duration within 30° of radar zenith.
    * Kwajalein requires two OMS engines with 10 seconds or greater duration within 30° of radar zenith.
    * Alice Springs requires two OMS engines with 10 seconds or greater duration.
- There are 30 acceptable burns, but only 20 are required for SIMPLEX completion. Of the 20 burns, at least 1 burn is required at each site during day or night.

4.2.2.1 On-orbit Attitude: No unique requirements

4.2.2.2 Thermal Environment: Not applicable

4.2.2.3 Photographic Coverage: Not applicable

4.2.2.4 Equipment Restraint: Not applicable

4.2.2.5 Flight Evaporation System and Water Dump Operations: It is highly desirable that Flight Evaporation System (FES), water dumps, and fuel cell purges, be inhibited during cooperative SIMPLEX operations.

4.2.2.6 Other Constraints: Not applicable

4.2.3 Safe Without Services.- Not applicable

5.0 PAYLOAD-TO-SPACE SHUTTLE INTERFACES

Not applicable

6.0 ENVIRONMENTAL ANALYSES AND INTERFACES

Not applicable

7.0 INTEGRATION HARDWARE

Not applicable

8.0 FLIGHT OPERATIONS

No unique requirements

8.1 Flight Design

No unique requirements

8.2 Flight Activity Planning

8.2.1 Flight Plan.- Annex 3 is not required.

The USAF/SMC will perform an analysis to identify which orbits meet SIMPLEX requirements. These opportunities will be provided to the SSP prior to the Flight Planning and Stowage Review (FPSR). The SSP will assess these opportunities for incorporation into the Flight Plan.

8.3 Training

Annex 7 is not required for this payload.

a. Customer point of contact for payload training, Capt. Don
    Hill, NASA/JSC/ZR1, 281-483-3425

b. Training time required per mission 1 hr or less

c. Tentative L- dates for such training, L-6 months

d. Estimates of crew travel requirements to non-JSC area
    facilities - none

8.4 Flight Operations Control

The SIMPLEX representative in the Mission Control Center (MCC)
will utilize real-time (and real-time propagated) Orbiter State
Vectors (SV's) to support the SIMPLEX opportunity planning and
assessment. Potential SIMPLEX test opportunities will be
available each day, and will be evaluated and identified for
flight planning.

8.5 Inflight Maintenance

Not applicable

8.6 Ground Data Interfaces

Not applicable

9.0 LAUNCH AND LANDING SITE OVERVIEW

Not applicable

10.0 SAFETY

The USAF will provide a detailed analysis of the ground-based
SIMPLEX equipment (i.e., laser power level and classification)
certifying that no hazard to the Space Shuttle crew or the
Orbiter is created by this equipment. The need for a formal
Safety Review will be determined by the hazard potential
involved.

11.0 INTERFACE VERIFICATION AND TESTING

Not applicable

12.0 POSTFLIGHT DATA REQUIREMENTS

The SSP is responsible for Space Shuttle system monitoring and anomaly resolution. In the event of a Space Shuttle anomaly which would influence the execution of payload objectives, SSP will supply the Space Shuttle data as available to the customer for evaluation.

In the event of a payload anomaly, SIMPLEX may require Space Shuttle data for evaluation of the payload problem.

Postflight data listed below will be provided as a nonstandard service.

	Reqd	N/R	Remarks
a. Closed Circuit Television (CCTV)		X	
b. Photographic		X	
c. Voice cassettes		X	
d. Annotated Flight Data File (FDF) notes	X		
e. Near Real-time (NRT) data	X		
1. Orbiter state vector and attitude	X		
2. OMS thruster firing data	X		
3. OMS gimbal angles	X		

Note: To accurately correlate SIMPLEX data with geophysical location, the customer requires standard Orbiter position, velocity, and attitude data throughout the duration of the payload activity. The SSP will provide NRT data to the customer containing the required information which includes the Orbiter

state vector (x, y, z, x Dot, y Dot, z Dot); attitude data and
time tag at a 1-sec data rate. For the period of the mission
where thruster emission data takes occur, the customer requires
OMS event histories. The NRT data consisting of the percent on
time for OMS thrusters at a 1-sec data rate, and the OMS chamber
pressures at a 25-sample per sec data rate satisfy this OMS event
history requirement.

13.0   SUMMARY OF NONSTANDARD AND CUSTOMER-FUNDED SERVICES

This section of the PIP identifies and sets forth all services to
be performed by the SSP for the customer that are currently
identified as nonstandard or customer-funded services. Except
for additional nonstandard SSP services identified in the future,
all other services to be provided by the SSP for the customer are
standard services.

A summary of nonstandard services identified herein to be
provided and priced to the customer for payload integration and
operations follows:

1.   Reference paragraph 12.0 - The SSP will provide postflight
      data to the customer as a nonstandard service (no charge).

Prior to initiation of individual nonstandard service(s), the
performing SSP organization and the customer will jointly scope
tasks, and the performing NASA organization will establish the
estimate of governmental costs and provide it to the customer.
The SSP will request, through a PIP amendment, the customers
approval of the task/cost and, provision of required funding.
The SSP will not initiate nonstandard service(s) until customer
approval of a PIP Change Request (CR) and funding is received.

KSC Launch and Landing Site Support is not applicable. JSC
nonstandard and customer-funded services are baselined according
to the fiscal year program operating plan submit and must be
revised annually to incorporate requirements for new payloads or
services not previously defined.

14.0   PAYLOAD INTEGRATION PLAN ANNEXES

The only required annex is Annex 2, Part II - Flight Planning

15.0 SCHEDULE

No unique requirements other than manifested launch date.

16.0 APPLICABLE DOCUMENTS

The following current issue document is considered applicable in
addition to standard baselined documentation:

a. NSTS 21000-SIP-MDK, Shuttle/Payload Standard Integration Plan
    for Middeck-Type Payloads

No Interface Control Document (ICD) is required.

APPENDIX A

TO-BE-RESOLVED ITEMS

None

APPENDIX B

TO-BE-DETERMINED ITEMS

None

APPENDIX C

ACRONYMS AND ABBREVIATIONS

CCTV   Closed Circuit Television
CMT   Cargo Management Team

FDF   Flight Data File
FES   Flash Evaporator System
FPSR   Flight Planning and Stowage Review

GSE   Ground Support Equipment
GSFC   Goddard Space Flight Center

ICD   Interface Control Document

JEA   Joint Endeavor Agreement
JSC   Lyndon B. Johnson Space Center

KSC   John F. Kennedy Space Center

L-   Launch Minus
LCC   Launch Commit Criteria
LSA   Launch Services Agreement

MMT   Mission Management Team
MOA   Memorandum of Agreement

N/R   Not Required
NASA   National Aeronautics and Space Administration

OMS   Orbital Maneuvering System

PIP   Payload Integration Plan

SIP   Standard Integration Plan
SSP   Space Shuttle Program

TBD   To Be Determined
TBR   To Be Resolved

PRINTING COMPLETED